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Evaluation of Water Recycling
in
Santa Clara County

Report to

Santa Clara Valley Water District

by

Foster Associates, Inc.

December, 1997

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120 Montgomery Street, # 1776 San Francisco CA 94104

Report Summary

Evaluation of Water Recycling in Santa Clara County

1. Recommendations

- A tax on imported water does not seem appropriate. The proposal is addressed at reducing the level of imported water in an attempt to reduce flows through the wastewater system. The source of excess wastewater flows is indoor water use, so any tax should be placed on that use rather than on imported water. Two other options are a tax directly on the amount of water discharged and a cooperative program to target indoor water conservation.

- For the District, water recycling programs and conservation programs provide similar benefits, and should receive similar levels of District spending per acre-foot, unless differences can be clearly justified.

- Payments to recycling programs should be based on avoided costs for water supply. The avoided cost calculation should include lost revenues to the District. However, these should reflect the revenues actually lost. Where recycling is serving agricultural users or the South County, the deduction for lost revenues should be lowered accordingly. This payment could be increased in recognition of other benefits, such as political benefits and insurance against water supply risk.

- If the adjusted payment described above is not adopted, the current rate subsidy to agriculture will always pose a disincentive for those users to switch to recycled water. It also fails to provide incentives for conservation. The District should consider changing its subsidy to a direct payment for land use rather than subsidizing water use. This could be structured to have a neutral revenue effect on farmers as a group. Provisions to protect watershed could be added, and the District's program could be coordinated with other county land-use/watershed programs.

- Agriculture in Santa Clara County is currently paying considerably less for the water used to produce similar crops in many other counties. The exceptions to this are the producers of cherries and bell peppers, who compete with producers in San Joaquin County that face similar costs for water.

- The potential for the District to retain some of the incentive moneys to promote use of recycled water does not seem appropriate at this point. Most current programs are small in size, and include close one-on-one contact between the wastewater agencies and the end-users. The District should reconsider this role in specific instances, particularly where it is acting as a wholesaler of the water.

- The District's avoided costs will be low in the near future, because many of its costs are fixed. This means that the District will have greater benefits (and should pay higher incentives) for recycled water projects coming on-line in the future. The District and the recycling agencies should consider three options:

    1. Payments based on current avoided costs. These would be low in the early years, but high in the later years.

2. Payments based on avoided costs over the life of the project. These would be higher in the earlier years, but remain stable over the life of the project. If new recycling projects come on-line at a later date, those would be paid at a higher rate than the older projects are paid.

3. Payments that are based on an adopted formula, that can be adjusted as uncertainties become resolved.

Each of these options would require the assumption of different levels of risk on the part of the District and the water recycling agencies.

- The level of long-term avoided costs is currently uncertain, and should be reviewed in the light of upcoming CALFED and CVPIA analyses. The current payment level does not seem unreasonable in the light of current cost expectations. However, these could change significantly in the near future.

The Board could consider additional payments to recycled water projects to reflect benefits other than those to water supply, and unquantifiable benefits to water supply. These are outlined and evaluated in the following sections. Rate impacts will be modest for all incentive options. More significant rate impacts would occur if the District undertakes a wholesaler role and constructs pipelines.

2. Benefits and Costs of Recycling Programs

The following table outlines the benefits and costs of recycled water programs other than the project costs.

Benefits and Costs		
Category	**Level**	**Comment**
Environmental/ recreational/ aesthetic	Low	Large potential benefits because of the South Bay's unique environments. Few projects will contribute significantly. Some could have negative effects
Economic	Low	2.5 jobs per TAF from retained in-county spending for water supply.
Risk avoidance	Moderate	Discussed in Section 2 below.
Political	High	Water recycling is seen as an important part of any CALFED solution. May be needed to qualify as a "good citizen." May also be needed to gain local political and public acceptance.
Water supply	Mixed	Benefits will be low in short-term. Discussed in Section 3 below.

3. Risks to Water Supply

The major benefit from recycling will be to insure the county against potential risks to future water supply. The IWRP recognized these risks, but because they are not quantifiable they were not explicitly included in the IWRP analysis. It should be stressed that most of these risks do not have a high probability of occurrence, and the District staff are working to reduce these risks. The levels of risk described below are subjective estimates that should be reviewed and modified

Risks to District Water Supplies

Risks in the next 5 - 20 years

Category	**Level**	**Comments**
Local environmental requirements	High	Increased requirements for local streamflows are very likely. Level required still undetermined.
Reduced allocation of imported water	Moderate	Hetch Hetchy supplies likely to be reduced, but IWRP less optimistic than San Francisco's current planning.
Earthquake	Moderate/ low	Earthquake on Hayward Fault could cause supply interruption. Current local storage possibly sufficient.
CALFED failure	Moderate/ low	High-cost proposals could lead to breakdown in consensus. Impacts highly speculative.
Barriers to water transfers	Low	While hurdles remain, this market is likely to develop. Flexibility of dry-year options very important to District's future. While probability is low, failure would be important.
Changed allocation from adaptive management	Low	Allocation could be increased/decreased depending on fish recovery. Direction and impact uncertain.
Failure to achieve conservation targets	Low	State mandates will require increasing levels of conservation.
Increased demand growth	Minimal	IWRP is based on high demand. Downside risk (lower demand) is more likely.
Failure to obtain banking contracts	Minimal	Banking contracts available/active
Longer-term Risks		
Wastewater disposal bypasses recycled water	Moderate/ high	If other uses are found for wastewater streams, District may lose option for recovery as a water source.
Recycled programs develop without a District role.	Moderate/ high	Delayed/reduced involvement may eliminate District's ability to become involved at a later date.
CALFED collapse prevents/ delays new facilities.	Moderate/ low	Delay is more likely than a ban on new facilities, but neither have high probabilities.

4. Water Supply Costs

In the next twenty years, water recycling programs will save the following costs:

- variable costs of imported water from the Central Valley Project;
- purchases of dry-year options; and
- variable costs for water treatment of imported water or groundwater percolation.

In the longer term, recycled water can allow the District to reduce its investment in new storage facilities and possibly in treatment plants for imported water. However, these savings must be discounted. The choice of an appropriate discount rate can be controversial. We recommend the use of the District's marginal cost of capital, or 6 percent. Water recycling can be a direct substitute for water conservation. It cannot substitute for banking; indeed, increased water recycling capacity may justify increased banking capacity.

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Evaluation of Water Recycling In Santa Clara County

1. Introduction

The Santa Clara Valley Water District (District) recently adopted an Integrated Water Resources Plan (IWRP) that outlines an approach for ensuring future water supplies to the county. In the IWRP, water recycling was specifically recognized as an integral part of the county's future. This report will document, describe, and, where possible, provide monetary values for the benefits and costs associated with water recycling.

The potential benefits and costs fall into five major areas, as follows:

- water supply reliability, including uncertainties associated with water supplies;
- water supply costs;
- environmental benefits and costs;
- employment and income benefits and
- political benefits.

Discussion of these factors will assist the District Board in determining the justifiable level of support for recycling projects. As the agency responsible for water supply planning in the county, the District should carefully consider supporting these projects to the extent that they provide water supply benefits to the county. The District should also consider the effect of other District policies on water recycling, and contemplate modification of policies that might act as a restraint on water recycling. This report discusses some of those policies, and how they might be modified. The report also highlights facets of recycling programs that could provide other benefits to the county, including environmental improvements

2. Water Supply Reliability

The District might wish to foster water recycling as an insurance policy against future risks to water supply. Concerns over the reliability of future water supplies are a major impetus for the District's interest in water recycling. The water shortages in 1988-1991 imposed significant hardship on the people of Santa Clara County, and threatened to constrain economic growth in the county's vibrant, high-tech economy which relies so significantly on water imported by the District. In the years since the 1991 drought, District staff have worked on a many-faceted strategy to increase the ability of the water supply portfolio to meet future demand reliably. This approach has included water conservation programs, water banking, and negotiations with other contractors of the Central Valley Project (CVP) and the State Water Project (SWP) to increase the reliability of those supplies to the District. These efforts have been successful, and based on the analysis in the IWRP, staff members believe they have developed a strategy which will enable them to meet all demands through the year 2020 under any of the water supply conditions experienced over the last seventy five years.

The District has analyzed the hydrologic risk associated with these supplies by looking at water availability over those seventy five years. However, there are other risks that cannot be assessed by reviewing historical experience. These risks must be assessed on a qualitative basis, using the best judgements of the decision-makers.

The next section describes these risks, and provides a preliminary evaluations of the importance of each risk. These evaluations are necessarily subjective, and should be adjusted by the reader in the light of his or her knowledge and experience. A formal method that could be used for assessing the value of these benefits is a Delphi survey of District Board members or other knowledgeable water supply personnel to develop their assessment of the risks posed by these factors.

2.1 Intermediate-Term Risks to Water Supply

These are risks associated with events that have the potential to occur in the next five to twenty years. They have not occurred yet, but they could occur within the District's planning horizon. It should be stressed that we are not suggesting that any of these events are likely to occur. In fact, many of these events are judged to have a low probability of occurring, but the District Board may want to keep them in mind when planning for the county's future water supply.

Local environmental requirements: Probability of occurrence: High

The California Department of Fish and Game (CDFG) has recently made a recommendation to the State Water Resources Control Board that the District's water diversion rights be revised. CDFG wants the Board to require higher cold-water stream flows on Guadalupe River and Stevens and Coyote Creeks, primarily to protect trout species (rainbow and steelhead are two major species). The District's previous practice of building gravel dams in streams to increase groundwater percolation has also been temporarily suspended while the environmental impacts are reviewed.

No decision has been reached on these issues, but it is likely that some increased level of local water supplies will be devoted to environmental uses in the future. Increased releases from dams, or reduced groundwater percolation will decrease the amount of local runoff captured for water supply, and make the District more dependent on water supply imports.

Reduced future allocations of imported water: Probability of occurrence: Moderate

Ongoing SWRCB and CALFED processes are changing the amount of water that agencies can import from the Delta watershed. The likely final allocations are not clear, but some indications can be gained from the SWRCB's draft Decision 1630. There are two separate standards that could influence the outcome.

- Water flow requirements at Vernalis. This proposed standard can only be met by reduced water allocations to agencies diverting water from upstream in the San Joaquin River watershed. The affected agencies are opposing this facet of the proposed decision, arguing that the proposed flow standards at Vernalis are arbitrary and lack scientific basis.

- Water salinity standards in the Delta. These standards could be met either by reducing exports at the Delta pumps, or by a combination of reduced exports at the pumps and reduced upstream diversions.

The hydrologic modeling used for the IWRP assumed that the proposed Vernalis standards would be met by an unspecified source of water, but that other water quality requirements would be met solely by the CVP and the SWP. This is a worst-case assumption, in that it is likely that the responsibility for meeting these standards will be assigned to all users of water from the Sacramento/San Joaquin watershed. However, the modeling assumptions for the Vernalis standard results in additional water being available for the flow requirements in the Delta. If the adopted Vernalis standards are lower than currently proposed, this would require reduced diversions from other users to maintain appropriate salinity in the Delta. Under this case and the worst-case assumptions for Delta responsibility, the District's water supply through the CVP and SWP could potentially decrease by an annual average of approximately 30 TAF per year. Under the more optimistic (but also more likely) Delta assumptions, the allocations could remain as assumed in the IWRP or possibly be increased slightly.

The more likely outcome is that the Vernalis standards (or something close to them) will be upheld, and that responsibility for Delta water quality will be assigned to a broader group of users from the watershed. While this will maintain or improve water availability to the District, it could lead to a decrease in Hetch-Hetchy water supplies. This could occur either through a new SWRCB decision, or through current Federal Energy Regulatory Commission investigations into the operations of New Don Pedro Dam. Any reduction of Hetch-Hetchy water would provide some protection for District water supplies from the Delta, but would reduce supplies from Hetch-Hetchy to cities in the south bay area, including some who obtain water supplies from the District. While the District's supplies are likely to be protected, the water supply position of the area would deteriorate as a result of reductions in Hetch-Hetchy supplies. The IWRP did assume reduced Hetch-Hetchy supplies, but the appropriate level of that reduction is unclear.

Earthquake: Probability of occurrence: Moderate/low

An earthquake on the faultlines in the East Bay/Delta area could disrupt conveyance systems. While the probability of some earthquake occurrence is high, local storage could likely cope with short to intermediate length disruptions. Agency staff should conduct engineering studies to estimate the probable length of time required to repair facilities likely to be damaged, and determine whether local storage is probable to be adequate.

CALFED failure: Probability of occurrence: Moderate/low

The CALFED process is attempting to build consensus over new operations and facilities in the Delta. The goals of the process include protecting the reliability and quality of water supplies and protecting ecological processes in the Delta. There are still differences of opinion as to what a "solution" should entail. In particular, agricultural interests stress a need to protect their water supplies while maintaining low costs. This is probably unrealistic. However, high-cost proposals could lead to agricultural interests leaving the process; similarly, environmental interests could withdraw if they feel that their interests are insufficiently protected. If this occurs, progress on solving Delta problems could come to a halt. This would lead to decreasing reliability of Project water supplies.

Barriers to water transfers: Probability of occurrence: Low

The operational flexibility to be gained through dry-year options is very important to the District. While probability is low, failure would be important. There are several reasons for being concerned about the achievement of this goal.

- There is growing public opposition to water transfers that rely on the substitution of groundwater for surface water. Many of California's aquifers are already overdrawn, and parties have argued that serious consequences could arise from adoption of a public policy that encouraged this situation to deteriorate further. The opposition also points to third-party impacts: water users who are not party to the contract are disadvantaged by the consequent lowering of the water table.

- Despite continued efforts on the part of Metropolitan Water District of Southern California and Santa Clara Valley Water District, no long-term dry-year option contracts have yet been successfully concluded. Single-year contracts between agricultural customers are becoming more wide-spread, and permanent sales of water rights have also occurred. To date, all proposed long-term option contracts have failed to be finalized.

Uncertainty over the availability of dry-year transfers is important. Dry-year water transfers, if available, could readily substitute for any shortfall in conservation and recycling. Because of their flexibility, the major part of the payment for dry year transfers will be made when the transfers are needed. This contrasts with recycling and conservation which must be invested in well before any certain need can be identified, and through wet years as well as dry.

The state as a whole is depending on water transfers to solve a range of water supply problems, so there will be a great deal of pressure for markets to develop. The District has been offered a contract for transfer water, but it has yet to finalize these contracts or to gain regulatory approval.

Changed allocation from adaptive management: Probability of occurrence: Low

The CALFED process has four goals: one of these is to enhance fish and ecological processes in the Delta; another is to increase the reliability of water supplies. CALFED proposes to take an "adaptive management" approach to its program. Under this approach, the effect of strategies implemented will be monitored, and modifications made in response to experience gained. While the CALFED process will institute a procedure to provide assurances that water supply reliability will be respected, the costs of maintaining that supply might be high.

Failure to achieve conservation targets: Probability of occurrence: Low

The District has an ongoing conservation program, and the California Urban Water Conservation Council has adopted new Best Management Practices (BMPs) that more clearly specify the types of programs and implementation schedules. These will be monitored in increasingly quantitative way. In addition, state mandates (developed through CALFED and SWRCB) will require increasing levels of conservation in the future.

Increased demand growth: Probability of occurrence: Minimal

While the IWRP is based on a range of demands, contingency plans have been made to meet a high demand forecast that is very unlikely to be exceeded. In fact, the demand level is likely to be considerably lower than the high demand used in the IWRP.

Failure to obtain banking contracts: Probability of occurrence: Minimal

District staff have actively pursued contracts for groundwater banking, and has existing contracts or options for storage equal to the full amount identified as a goal for the year 2020.

2.2 Longer-Term Risks to Water Supply

These risks to the District water supply are longer-term, and will not impact the agency in the intermediate future. However, the District should be aware of these risks so that it can work to avoid them, if necessary.

Wastewater disposal bypasses recycled water: Probability of occurrence: Moderate/high

Many of the wastewater agencies have a need to dispose of wastewater flows in the immediate future. They are examining options that include water recycling and environmental uses, among others. If other uses are found for wastewater streams, these streams may not be available for water supply augmentation in future. For example, if wastewater is used for environmental enhancement, habitat will be created that may support endangered species. The District will not be able to reclaim this water for other uses.

There are two scenarios under which the District would need expanded recycled water in future. These are:

- where the demand for water in the county increases into the period after 2020. If this is the case, wastewater flows will also be increasing, and the wastewater agencies will need to dispose of those additional flows. These increased flows would still be available for recycling, so while the District would have limited wastewater available for reclamation, some will be available.

- where demand stays stable, but existing supplies become considerably less reliable. If this is the case, the District would need new supplies but the flows of wastewater would not be increasing. Under this scenario, the permitted wastewater flows up to the regulatory cap would still be available for recycling, but this would be at the District's expense. The wastewater agency would have no requirement to dispose of these flows, and would not share in the cost of such a recycling project.

By limiting the amount of recycled water developed at this time, the District may lose the ability to recycle some water for all time into the future. There will always be some ability to increase recycled water in the indefinite future, but if recycling is postponed until a time when it is not needed by the wastewater agencies, the District will need to bear the full cost of recycling.

Recycled programs develop without a District role: Probability of occurrence: Moderate/high

If the District does not become involved in water recycling at this early stage, a water recycling infrastructure and organization may develop without District involvement. If the District later decided it wanted to be fully involved in water recycling, there may be no role for the District to play. This may or may not be of concern to the District Board.

CALFED collapse prevents/delays new facilities: Moderate/low

The District currently expects to need new reservoir storage at some time after 2020. If CALFED is unable to develop a solution to Delta issues, additional facilities (such as improved through-Delta transportation or additional surface storage) could be prevented or indefinitely delayed. This could provide long-term difficulties with water supplies in the county, and require investments in water recycling

3. Water Supply Costs

There are two aspects of water supply costs that are affected by water recycling. The first category of these is made up of those costs that may be avoided by increased water recycling projects, and so are benefits arising from the projects. The second category are costs that the District is considering incurring to encourage recycling projects, and so are direct costs incurred by the District that should be balanced against those avoided costs.

3.1 Costs Avoided by Recycling

The staff estimate that the District has adequate water to meet requirements in all but the driest years. While detailed hydrologic modeling is needed to determine exactly how operations would change with different levels of water supplies, costs could be reduced by turning back Central Valley Project water in years where excess supplies are available. This is estimated to save a total of $28.39 per AF in variable charges from the CVP and $7 in operating costs at San Felipe.

However, in dry years the supply may not be adequate. By the year 2020, the District has determined that additional supplies will be needed. Current efforts at ensuring future water supplies are focused on the implementing the following strategy:

- Development of water banking contracts. Some contracts are in place, and will supply water in dry years at an estimated cost of $195 to $300 per AF.

- Development of water transfer projects. Offers have been received for transfers that would deliver water in dry years for an estimated $300 per AF. The District has not yet accepted these offers, and presumably will negotiate a lower price.

- Implementation of water conservation programs. These are underway, and have achieved water use reductions at costs estimated to range from $140 to $300 per AF.

- Water recycling. The District currently offers an incentive of $115 per AF to encourage water recycling. It is investigating other options to work with wastewater agencies on recycling projects.

- Involvement in the CALFED process to protect existing imported water supplies. The cost of this strategy is not yet known.

At first sight, these costs make the amount the District is spending on recycling seem disproportionately low. However, for both banking and water transfers the water is provided only when it is most valued by the District. In the year 2020, it is estimated that water transfers will be required in 20 out of 75 years; in the years between now and 2020, the transfer water will be used even less often.

The District has been offered water transfers under a contract that would require the District to pay $10 per AF as a "reservation fee" in years that the transferred water is not required, and $250 per AF when the water is used. This is a proposed contract, and the District would likely negotiate lower terms than these. However, it provides an upper bound to compare with the incentive payment to recycling. The following table uses these values to estimate the costs that the District would avoid if it used recycled water instead of CVP water in wet and normal years, and instead of water transfers in dry years.

It should be stressed that these numbers are biased upwards, for the following reasons:

- The estimated proportion of years that water transfers would be required is based on year 2020 demands. In years with lower demands (the years from 1997 through 2020) the likelihood of needing water transfers would be much less.

- The transfer price shown is the offered price; the District is likely to negotiate lower terms.

Although the proportion of years when transfers are needed is based on the high demand forecast for the year 2020, this does not cause an upward bias in the results. Like all water agencies, the District is

Table 1
Imported Water Costs Avoided by Water Recycling
($/AF of Water Supply)

Avoided Cost Category	Estimated Cost	Source
Normal/Wet Years		
Variable CVP	$28.39	1997 CVP Rate Book
San Felipe	$7.00	Jeff Micko, SCVWD
Transfer reservation fee	$10.00	Joan Maher, SCVWD
Total	$45.39	Applied for 55 years out of 75
Water Transfer Costs		
Dry Years		
Purchased Water	$250.00	Joan Maher, SCVWD
Variable O&M for SWP and South Bay Aqueduct	$36.00	Jeff Micko, SCVWD
Total	$286.00	Applied for 20 years out of 75
Weighted annual average	$109.55	
Local Savings		
Treatment	$35.00	Estimated cost of ozonation.
Percolation	$30.00	Jeff Micko, SCVWD
Average	$32.50	
Total	$142.05	

planning a strategy to meet the highest likely demand. The estimate of the benefit from water recycling should be based on the same level of demand as is other planning.

In addition to these savings, water recycling could potentially save an estimated $500 per AF in new facilities costs after 2020. Because these savings are very distant in time, they should be discounted to measure the benefit to today's consumers of these avoided costs. Table 2 summarizes the results when this $500 is discounted from 2021 to 2037. This endpoint was chosen to reflect a forty-year life for a recycling project coming on-line at the end of 1997. The reported discounted values result from three different discount rates: 3, 6 and 9 percent. These three values were chosen because there is some controversy over the appropriate discount level. The rates used correspond to the various position taken on discount rates. The arguments for each of these positions are summarized below.

- **Intergenerational Equity:** This argument states that a public agency should not share the fixation with short-term outlooks that is widespread in the rest of the economy. High discount rates reflect this requirement for short-term payback, and so investments chosen today on the basis of high discount rates will inevitably favor today's water consumers while providing less weight to the benefit of future consumers. Using a discount rate that recognizes only the rate of inflation gives the well-being of future consumers the same weight as the interests of current consumers. The 3 percent discount rate reflects this argument.

- **Cost of Doing Business:** The District has a choice between paying money today and increasing today's level of borrowing, or paying money at a later stage and holding down the current level of borrowing. The cost to the District of advancing payments (or the benefit of postponing current payments) is the marginal cost of debt to the District. Our use of a 6 percent discount rate reflects this argument.

- **Revealed Time-Preference:** This argument points out that the public as a group has a very high preference for money today rather than money tomorrow. This is demonstrated in markets by businesses with investment return goals (hurdle rates) of 20 percent or more, and individual credit card debt that is undertaken even at interest rate levels of 17 or 18 percent. Because public agencies are acting as agents for the public, they should reflect this public preference for delayed payments by using a higher discount rate. Proponents of this argument might advocate the use of a higher discount rate than the 9 percent we adopted to reflect this argument.

Table 2
Avoided Cost Estimates
($/AF)

Assumptions Discount Rate	3%	6%	9%
High Forecast $500/AF new supplies	$145	$91	$55

We believe that the appropriate discount rate to use is the District's cost of new borrowing, and so we advocate the adoption of the 6 percent discount rate. When combined with the $141 from Table 1, this would result in an estimated upper bound to the avoided cost of $233 per AF. This appears to be the maximum benefit that the District would gain from recycled water.

However, the District will lose revenue from the water sales that are lost through the conversion to recycled water. The major part of the water sold by the District brings in revenues of $240 per AF. In most cases, this revenue loss will equal the avoided cost benefits to the District, so at present the District's net benefit from recycled water would be zero. However, where recycled water is sold in the South County or to agricultural customers, the loss of revenue would be significantly lowered. In these cases, the net benefit to the District would be much higher, and defines the avoided cost measure of payments that could be made to water recycling projects.

These estimates needs to be refined with the additional information that will be available in the near future from the CVPIA draft EIR and the upcoming CALFED draft EIR. The CVPIA analysis will include additional hydrologic estimates of future deliveries to the District. The CALFED report will provide the District with better estimates of costs and deliveries for current and future supplies from the Delta. The District should reexamine its requirements for new supplies in the light of this new information. The analysis undertaken should include the following features:

- water supplies and demands should be examined for at least the year 2000 and 2020. This analysis should examine the high forecast for both years, and identify how the system's operations would change in both years if recycled water and water conservation were not available.

- The changes in costs that result from these changes in water supply operations should be estimated. This is likely to be very low in the year 2000, and higher in the year 2020. The change should them be divided by the AF of recycled water and conservation that is expected to be available in each of those years, to give a per-unit benefit estimate.

- The CALFED estimates of new supply costs and estimated dates of availability can be used to refine the benefits in later years.

- These benefit streams can be discounted to get an estimate of today's benefit per AF from both recycled water and water conservation.

The District should then add an estimate of the treatment costs saved, and subtract the actual revenue that would be lost to arrive at a minimum amount it would be prepared to pay to obtain recycled water supplies or water conservation. Unless the new data is significantly different from the data analyzed above, the likely result is that the District's current payment will be found to be a generous estimate of the avoided cost benefits of recycled water.

This avoided cost estimate should also be used to judge the cost-effectiveness of water conservation projects, as required under the Memorandum of Understanding for water conservation best management practices. Conservation and water recycling provide similar benefits to the District, suggesting that the District should spend similar amounts per AF on both of these programs. Any differences in spending on these programs should be clearly justified. Two differences that have been identified to date are:

- water conservation is more flexible, because spending can be stopped if conservation is judged unnecessary. This flexibility is somewhat overstated, because the costs for water conservation are spent up-front and cannot be recaptured if an investment is later felt to have not achieved its goal.

- water recycling is more certain, because at when the District pays for recycled water it knows how much it is getting and for what period of time. It can be argued that the long-term savings from conservation are less certain. This can be overcome by careful choice of the assumed lifetime of the conservation saving.

To the extent that these or other claims are believed to be appropriate, variations in the incentive payments to the two programs can be justified.

3.2 Water Supply Costs From Water Recycling

The District's costs from water recycling come from two sources: the level of incentive paid to water recycling projects, and the revenue lost because of recycled water sales that would have otherwise been served from potable water supplies. The impact of these costs are described below.

Incentive Payments

The District currently offers an incentive payment of $115 per AF for recycled water that displaces potable supplies. Other levels of support have been suggested, including the following:

- $225 per AF has been suggested because this is the estimated cost reported in the IWRP of the District's programs to encourage water conservation. This argument appears to be justified, because water conservation and water recycling provide similar benefits to the District, and both result in similar losses of revenue. However, this raises the question of why the recycling programs are funded to this level when the avoided cost of imported water is much lower.

- $250 - $330 has been suggested because this is the estimated cost reported in the IWRP of the District's water banking program. This argument is less justified because water banking and water recycling are not good substitutes. Water banking provides water supplies in dry years when it is most needed and therefore most valuable. Water recycling provides water in all years, including wet years when excess water is available for very low prices, and dry years when water is much more expensive. In fact, water recycling and water banking are complimentary rather than substitutes, because the additional water available in wet years must lead either to increasing turnbacks of imported water or contracting for increasing water banking capacity.

Each of these alternative incentive levels would result in a stream of payments per AF for recycled water over the expected life of the plant. The present value of those payment streams, assuming payment begins in 1998 and continue for 40 years, are compared in Table 3 below.

Table 3
Present Value of Expected Payment Streams
(per AF)

	Discount Rates		
Incentive Level	3%	6%	9%
$115	$2,658	$1,730	$1,237
$225	$5,201	$3,385	$2,420
$250	$5,779	$3,762	$2,689
$330	$7,627	$4,965	$3,550

Source: Foster Associates, Inc.

Foster developed a financial model to estimate the effect of these payments on future water rates. We began with the District's current financial and rate model, and extended this model to the year 2020. This should not be considered a rate forecast; values for expected future expenses and financing were developed by simple trend, rather than by careful analysis. Scenarios were prepared for each of the incentive levels outlined above. The resultant rate forecasts are presented in Table 4.

Table 4
North County M&I Rate Forecasts
2020

Incentive Level ($/AF)	Rate ($/AF)	Annual Payments ($000)
$115	$490	$2,300
$225	$496	$4,500
$250	$496	$5,000
$320	$498	$6,600

Source: Foster Associates adaptation of District model

It should be noted that the four incentive levels cause rates to change very little. The rate stability results from the small amount of recycled water assumed, building to 20 TAF in the year 2020. In that year, the annual payments to water recycling projects are estimated to be between $2.3 million and $6.6 million, depending on the level of incentive. While these are large sums of money, they do not make a large difference to the level of water rates charged.

Lost Revenue

In addition to these costs, the District will lose the revenues from the sales that would have been made from potable water supplies but are now supplied with recycled water. These revenues would have contributed to the fixed costs that will still need to be covered by remaining customers. In the District's officially-adopted calculation of the incentive rate for reclaimed water, the estimate of lost revenue is based on the North County rate for groundwater supplies. This would seem to be the most appropriate rate to use for a general-purpose incentive for alternative supplies: the North County has by far the largest proportion of water use, and any existing water users who would switch to reclaimed water are more likely to be existing users of groundwater than of treated water.

When the analysis becomes more specific, the appropriateness of this measure becomes less clear. In some cases, the lost revenue will come from agricultural customers who are not charged the full groundwater rate. In addition, current North County rates are higher than South County rates. Any adjustment made for loss of revenues should reflect the particular situation of the recycled water project. Where the recycled water is to be used to supplant potable sales to South County agriculture, the lost revenue adjustment should be made on the basis of South County agriculture rates. However, this provides water recyclers with an incentive to serve agricultural users rather than the most efficient customer mix, and could lead to uneconomic choices on the part of the recycling agency. This issue is explored more fully in Section 6, where we discuss the implications for water recycling of the District's current agricultural rate policy.

3.3 Alternative Structures for Incentive Payments

The estimate of incentive payments outlined above looks at all future benefits for a recycling project undertaken today. This assumes that the incentive payments will stay fixed over the life of the recycling project. Because of this assumption, the avoided cost estimates are levelized to result in equal payments per AF per year over an assumed 40-year life. This commits the District to pay a certain amount of for recycled water regardless of the benefits to the District. If the benefits are less than forecast, the District will be paying more for recycled water than it is worth to consumers; if the benefits are greater than forecast, the District will be paying less for recycled water than it is worth.

Recycled water plants coming on-line later in time will be worth more to the District, because the longer recycling projects are delayed, the higher the avoided cost. This is because in the near term the benefits from avoided water supply costs are very low. In the more distant future, the avoided cost will be larger because it will reflect savings from the reduced need for water supplies from new facilities. This has two implications. First, the closer in time the District is to needing new supplies, the higher its incentive payment should be, to encourage wastewater agencies to invest in recycled water. However, if the incentive payment is based on an equal payment over the life of each project, two water recycling facilities operating in the year 2010 but coming on-line in different years, will have differing incentive payments.

This complication could be avoided by paying to recycling agencies the actual costs avoided in any one year. This would be, in effect, developing a market for water and allowing the water recycling agencies to collect high incentives when water is scarce, and lower incentives when water is plentiful. From Table 1, this would mean that in wet years the incentive would be $78 per AF, and in dry years would be $318.50. These estimates are detailed in Table 5.

Table 5
Imported Water Costs Avoided by Water Recycling
($/AF of Water Supply)

Avoided Cost Category	Estimated Cost	Source
Normal/Wet Years		
Imported water	$45.39	
Local savings	$32.50	
Total Normal/Wet Years	$77.89	Expected for 55 years out of 75
Water Transfer Costs		
Dry Years		
Imported water	$286.00	
Local savings	$ 32.50	
Total	$318.50	Expected for 20 years out of 75

These estimates ignore the District's loss of revenue from reduced sales of potable water. Taking this into account, the water supply benefits vary according to the end-uses supplied by recycled water. In normal and wet years, the supply of recycled water to M&I customers is a net detriment to the District, while the supply of recycled water to agriculture is a benefit to the District in all year-types.

If incentives are paid on the basis of current benefits, as outlined above, the payments will vary from year to year, and, as supplies grow tighter the payments to recycled water will increase. If the District is overestimating the reliability of future supplies, the levelized benefits will provide more total income to recycled water over time. In contrast, if the District is underestimating the reliability of future supplies, the variable benefits will provide higher total payments to recycling over time. However, these higher payments will be delayed, and lower payments will be made in the near future. This varying level of payments will be less beneficial to wastewater suppliers in the short term.

By paying levelized costs to encourage water recycling in the near future, the District is assuming the risk arising from uncertainty associated with the demand forecast. If the District agrees to pay an incentive payment of $115 per AF, it runs the risk that it will be paying to avoid the cost of a future resource that it may never require.

4. Potential Environmental Benefits and Costs of Recycling

Water recycling in Santa Clara County has many potential environmental benefits and some environmental costs. A description of the environmental issues in the County is attached in the Appendix to this report. This section identifies and evaluates the most likely potential environmental effects. The major potential environmental benefits include the following:

- Reduced conversion of salt marsh;
- Reduced flow of metals contaminants to the Bay;
- Augmented stream flow;
- Reduction in future water diversions from the Delta;
- Developed or improved freshwater marshes or wetlands;
- Habitat maintenance during water supply shortages.

The key potential environmental cost arises from reduced discharges from wastewater plants, leading to reduced stream flows.

Each of these issues is evaluated in more detail in the following subsections.

4.1 Reduced Conversion of Salt Marsh

The Bay Area Regional Water Quality Control Board (BARWQCB) has required the South Bay wastewater dischargers to develop a plan to reduce the level of treated wastewater discharged to the Bay at the San Jose/Santa Clara Water Pollution Control Plant's discharge location. The high volume of fresh water entering the Bay is converting existing saltwater marshes to freshwater. This is resulting in the loss of important wildlife habitat, most importantly for the endangered California clapper rail and salt marsh harvest mouse. The South Bay agencies considered an option to extend the outfall to a location north of the Dumbarton Bridge, but decided instead to focus on a plan that included water conservation and water recycling. This plan is now under review by the BARWQCB.

The protection of the salt marshes is a direct result of the BARWQCB's regulation, and is not an environmental benefit that should be credited to water recycling. If the South Bay agencies decided to proceed with the alternative of constructing the longer outfall, the same salt marshes would be protected. In this case, the benefits associated with recycling arise from the avoided cost of the outfall. No environmental benefits for reduced salt marsh conversion should be credited unless the amount of salt marsh saved is greater than that required by the BARWQCB.

4.2 Reduced Flow of Metals Contaminants

Under the federal Clean Water Act, U.S. Environmental Protection Agency (USEPA) must develop regulations to restrict the amount of toxic contaminants entering the nation's waterways. USEPA has recently taken the first step in the direction of regulating contaminant flows in California by the release of its California Toxics Rule, but will defer to any state regulations that achieve substantially the same protection. The BARWQCB is drawing up a regulation that will control the Total Maximum Daily Loading (TMDL) that it will allow for important contaminants in San Francisco Bay.

Two of the most significant toxic contaminants in the South Bay are copper and mercury. These affect the health and reproductive success of fish in the Bay. Water recycling has been used to reduce flows of copper into the Bay, but the major source of copper in this region is from automotive brake linings. When adopted, the TMDLs will likely require source control programs to reduce the flow of these metals. Water recycling is unlikely to reduce toxic levels below that required by the TMDLs, so there will be no additional environmental benefit from reduced toxics above that required by the regulation. The major benefit from the reduction of toxics due to recycling is likely to be from reduced costs of source control programs.

4.3 Stream Flow Augmentation

Recycled water has been proposed to replace water currently provided by the District to maintain minimum flows in certain county streams to protect fish and other wildlife. Where this change results in no net increase in flows above those required of the District, there will be no environmental benefit. Rather, the benefit will result from the increased supplies of potable water made available to the District's consumers. Where the change to recycled water results in flows that are higher than those that would be required of the District, the environmental benefits of the net change should be credited to water recycling. In some cases the recycled water might be used to augment flows in streams where no minimum flows have been set. In such cases the environmental benefits should be assigned entirely to water recycling.

4.4 Reduction of Future Water Diversions from the Delta

Santa Clara County obtains approximately 50 percent of its water supplies from the Sacramento/San Joaquin Delta watershed. To the extent that recycled water replaces the need for potable water, the District's future need for increased diversions of water from the Delta will be reduced. The analysis here is similar to those in the previous subsections; environmental benefit will only occur when Delta outflow is greater than the regulatory requirement. In wet years, (when Delta water quality standards are surpassed) the water not diverted by the District will remain in the Delta and benefit fish that live in and pass through the Delta. In other years, the Delta water quality standards will be maintained, with no change to environmental conditions as a result of the recycling program. In years where the water quality standards are controlling, the extra water will be available to be diverted by other agencies that obtain water from the Delta, and so will provide no benefits for Delta wildlife during those years. District hydrology suggests that the additional water will only be available in the one wettest year in twenty-five. Augmented Delta flow is least useful during wet years, so the environmental benefit is likely to be small.

4.5 Development of Wetlands

In some cases, recycled water may be used to develop wetlands that are not directly required by regulation, but are necessary to avoid regulated discharges. In these cases, the benefits of recycling include both the avoided costs of other options, and the environmental benefits associated with the freshwater wetlands that are developed.

4.6 Habitat Maintenance During Water Supply Shortages

During water supply shortages outdoor water use is curtailed, and wildlife that has grown dependent on urban landscapes is hard-pressed. Landscape irrigated by recycled water will provide refuges for these wildlife during times of stress. Since the last drought, the District has undertaken many actions to increase the reliability of its water supply, and believes that it will not experience a water shortage in the years to 2020. To the extent that this effort has been successful, this environmental benefit is less valuable.

4.7 Environmental Costs

Where a wastewater treatment plant is discharging to a stream or river, conversion to water recycling may reduce discharge to the stream and thus reduce stream flow. This could have a detrimental effect on fish and wildlife associated with that stream. A potential example of this is the South County Regional Wastewater Authority (SCRWA), which has applied for a permit to discharge treated wastewater into the Pajaro River. SCRWA is also planning to recycle some of this discharge at a later date. The discharge into the river may have positive environmental effects which would be reversed if the wastewater is recycled.

4.8 Summary

Most of the water recycling projects in Santa Clara County that have environmental benefits are implemented to meet environmental standards mandated by regulators. If the water recycling programs were abandoned, these standards would still need to be met by other means. In these cases, the environmental benefit comes from the regulation rather than from the water recycling programs. Water recycling has been judged the most cost-effective method for attaining some regulatory standards. The major environmental benefits from recycled water appear likely to result from agencies that use the recycled water to construct wetlands or augment stream flows above the level required by regulation. While the county's water recycling program would reduce the District's water diversions from the Delta, hydrological studies suggest that this will benefit environmental conditions in the Delta only in the wettest of years, when the benefit is least effective. In other years the benefit of any reduced diversions by the District will be gained by other Delta water users.

5. Employment and Income Effects

For the next twenty years, the proposed recycling program will keep money in the county that would otherwise be used to pay for imported water supplies. This money is the equivalent of the avoided costs estimated in Table 1, not including the cost for treating the water once it is in the County. The money that would have been spent on moving CVP water to the county, or on paying for dry year transfer, will remain in the county and support additional jobs and spending here. In the early years, this amount is small or negative, but by the year 2020 the additional amount spent in-county has increased to $2.4 million. While this is not a small amount of money, compared to the gross product in the county of over $40 billion, this effect must be considered small. This level of retained spending could be expected to add less than 50 jobs to the county's total employment.

6. Political Benefits From Encouragement of Recycling

The District could gain political benefits from its encouragement of water recycling. These political benefits could come in the following forms:

- The SWRCB will increasingly expect some efforts at water recycling as a demonstration of "beneficial use" of the state's water resources. The appropriate level of these efforts have not been explicitly defined, and will likely reflect any findings made through the CALFED process.

- The CALFED process will rely on some level of water recycling to ensure reliable water supplies. Most likely this will be based on the specific circumstances of each water agency, and will reflect the level of avoided costs for each agency.

- The District's encouragement of water recycling may be seen as a contribution to the solution of regional problems, and foster inter-agency cooperation within the region.

- The District's encouragement of water recycling could be seen by environmental interests as indicating a progressive attitude and lead to a more cooperative approach on other issues.

7. Recycled Water and Agriculture

The District's charter requires that water rates to agricultural customers be held at a lower rate to encourage the maintenance of agricultural land-uses and lifestyles in the county. Any proposed rate changes for agriculture should be made with concern for possible negative effects on farmers in the region. As a first step to understand the competitive situation of the County's farmers, we examined the patterns of agricultural production in the county.

7.1 Agriculture in Santa Clara County

Table 6 shows the major crops grown in Santa Clara County in 1994 by dollar sales. Of these crops, the highest-valued production is from mushroom growing, which does not contribute to the open-space goal of the District's agricultural rate. The next two crops by dollar value, nursery products and cut flowers, use relatively little water or acreage, but contribute somewhat to the open space goal. The remaining crops, bell peppers, lettuce, cherries and grapes do contribute significantly to open-space goals.

Table 6 **Major Crop Production Categories in Santa Clara County**		
Crop	**Dollar Value** (millions)	**Cropped Acreage**
Mushrooms	$30.3	NR
Nursery Products	$24.1	NR
Cut Flowers	$21.6	NR
Bell Peppers	$10.8	2,320
Lettuce	$ 7.7	2,620
Cherries	$ 5.9	1,160
Grapes	$ 2.9	1,535

Source: County Agricultural Commissioner's Report, Santa Clara County, 1994.
NR = Not reported

This last set of crops are most important for open space and are also most likely to be negatively affected by changes in water supply costs in the county. To investigate the potential for placing the county's farmers at a competitive disadvantage, we first identified the major competitive sources for these crops within California. The counties that lead the production of these crops are identified in Table 7. It should be noted that overseas producers (particularly in Asia and South America) are major sources for cut flowers sold in the state. In conversations that were part of a recent survey, some florists reported obtaining all or nearly all of their stock from these overseas sources.

Table 7 **Santa Clara Crops and Leading County Producers**	
Crop	**Counties**
Mushrooms	Monterey, San Diego
Nursery	San Diego, Los Angeles, San Mateo
Flowers	San Diego, Monterey, San Mateo
Bell Peppers	Riverside, San Joaquin, Orange
Lettuce	Monterey, Imperial, San Luis Obispo
Cherries	San Joaquin, Tulare
Grapes	Fresno, Kern, Tulare

Source: California Agricultural Statistics, 1994.

7.2 Water Rates in Counties with Competing Agriculture

Agricultural rates were investigated for several of these counties to compare their circumstances to those in Santa Clara County. The major findings are discussed below.

7.2.1 Monterey County

The Monterey County Water Resources Agency is developing a water recycling project with proposed sales to agricultural users in the county. Revenues to cover costs will be gained from two sources:

- A recycled water rate of $7.50 per acre-foot (AF);
- A land assessment fee that is composed of two parts: one low rate per acre that applies to all land-owners; and a second, much higher part that applies to all irrigated agricultural acreage in the project area, whether or not those acres are irrigated using recycled water. For farmers in the project area, the total fee is $210 per acre. Using an assumed application rate of 2.5 acre-feet per acre, this approximates to a fee of about $85 per AF.

Current estimates put the cost of non-recycled water at $50 to $75 per AF. Therefore, within the project area the effective cost of water will increase to a range of $135 to $160 per AF for those farmers not using recycled water, and $60 to $80 per AF for those farmers using recycled water. This provides a strong incentive for farmers to convert to recycled water. By charging a fee to all land-owners, and a different, higher fee to all agricultural users regardless of the source of their irrigation water, the Agency is reflecting the fact that all land-owners benefit from the improvements in the aquifer that will be provided by the recycling project.

However, because such a large portion of the water costs are collected through the fixed assessment, the Agency has limited the options available to its farmers. Currently they must convert to recycled water, absorb the extra costs, or go out of business. If the fee had been structured as a water user fee instead of a land-ownership assessment, they would also have options for increased savings through water conservation. The Agency is presumably interested in maintaining agricultural production in the region while reducing the amount of water withdrawn from the aquifer. A water-use based fee would both provide their irrigators with more options and provide additional incentives to reduce aquifer withdrawals. There may have been institutional difficulties that undermined the acceptability of this rate structure.

7.2.2 Orange County

The Municipal Water District of Orange County (MWDOC) supplies water at wholesale to retail agencies. It does not supply any water directly to the end-users, but provides water to agricultural customers at discount rates. These rates are offered on two conditions:

- the agricultural customers agree to be interrupted at an earlier stage in a water supply shortage, before M&I supplies are interrupted. This is understood to require agricultural customers to reduce their water use by 30 percent before M&I customers are required to reduce their water usage.
- the amount of water available at this rate is strictly limited. If more agricultural water is applied for than the allocated amount, then the remaining water must be purchased at the full (unsubsidized) rate. The amount purchased at the full rate is not subject to early interruption.

The current wholesale rates for water supplied by MWDOC is as follows:

Table 8
Current Wholesale Water Rates, Orange County
($/AF)

Water Type	Agricultural	Other
Treated	$298.55	$435.55
Untreated	$240.55	$353.55

MWDOC does not sell recycled water. These programs are handled by the retail water suppliers, with the assistance of incentive payments from Metropolitan Water District of Southern California (MWD). One of the retail agencies with a recycling program is Orange County Water District. This agency serves limited agricultural acreage with recycled water; most of their recycled water goes to urban landscapes. In this agency, the water source that competes with recycled water is groundwater pumped from the managed aquifer by the water agency. There is no subsidy in agricultural rates for groundwater. The basic rate paid is $170 per AF, with additional charges for night-time use, and additional charges if the water must be delivered at pressure. The maximum rate is $260 per AF. The same rates are charged for recycled water.

7.2.3 San Diego County

Like Orange County, the San Diego County Water Authority offers water to agriculture at a discount rate that only applies where the water supply can be interrupted at times of drought, and where the amount of water that is discounted is strictly limited. Flower and nursery growers have generally not signed up for the reduced agricultural rates. It appears that they prefer to pay the higher rates to ensure greater supply reliability. The current retail rates at agencies within the county are shown in Table 9.

Once again, the water recycling programs are run by the retail agencies with the assistance of incentive payments from MWD. The rates charged by the agencies depend largely on the crops in their service territory. If they are serving high-value crops, (flowers and nursery), they tend to charge the same rate as for potable water. If they are serving crops where the profit margin is more narrow (avocados and citrus), they are more likely to provide a discount of 10 to 15 percent from the applicable rate for potable water.

San Diego has a problem with salt content. The potable (surface) water deliveries in this region are generally around 600 TDS, which is relatively high. The recycling agencies try to keep their supplies at below 1000 TDS, but are not always successful. This means that the discount of 10 to 15 percent may be required even where the development permit required the use of recycled water. If one agency offers a discount to encourage the use of recycled water, it becomes difficult for a neighboring agency to avoid offering a similar discount.

7.2.4 San Joaquin County

Farmers in this county grow cherries and bell peppers in competition with those grown in Santa Clara County. Cherries are grown in the eastern sector of the county around Linden, below the foothills. Water in this area could be obtained from groundwater or from imported surface water. The County Agricultural Commissioner estimates that water from these sources average from $30 to $60 per AF. Bell peppers and other truck crops are grown around Tracy, where the water costs could be as high as $80 per AF. This is significantly less than the cost of other water supplies quoted above.

Table 9
Current Retail Water Rates, San Diego County
($/AF)

City of San Diego	**Agricultural**	**Other**
Treated	$625	$625
Untreated	$434	NA
Fallbrook PUD		
Treated	$424	$577
Reclaimed	$407	$407

7.3 Agricultural Rate Policies

Santa Clara's water rates to agricultural customers are importantly determined by two non-cost factors. The first is a charter requirement in the District Act setting the agricultural water rate at a maximum of 25 percent of Municipal and Industrial (M&I) rates. The second is a $2 per AF charge on M&I water sales that is used to reduce agricultural charges. The justification for both of these subsidies is that the maintenance of agriculture within the county protects open-space and lifestyle amenities that are valued by all of the county's residents. The net result of these two policies are the rates outlined in Table 10.

Table 10
Santa Clara Valley Water District
Groundwater Rate Levels for FY 1996-1997
($/AF)

	M&I Users	Agricultural Users
North County	$240.00	$43.75
South County	$108.00	$11.50

Source: Water Utility Enterprise Preliminary Report, Santa Clara Valley Water District, April, 1996.

The unfortunate side-effects of this subsidy include: unfair competition between subsidized Santa Clara water rates and reclaimed water; and discouragement for conservation by agricultural users. If the incentive for recycled water maintains the subsidy, this will provide an incentive for the water recycling agencies to provide recycled water to agriculture rather than to other users. This may not always be the most economic use of the water.

There are limited options to alleviate this situation, because a large amount of this subsidy is required by Santa Clara's charter. However, it would be preferable for many reasons to provide the subsidy on a per-acre basis rather than the current methodology which is based on the water consumed. These reasons include the following:

1. The subsidy is in place to help retain the county's open spaces, and thus to maintain the quality of life in the county. A subsidy based on farmed acres would be subsidizing the factor that is valued

(agricultural acreage) rather than indirectly encouraging the desired outcome through encouragement of a factor that is not necessarily seen as desirable (agricultural water use).

2. If farmers were given a bill based on $108 per acre-foot, with a rebate separately listed of $96.50 per acre, this would provide necessary encouragement for water conservation and growing crops with lower water needs while maintaining low total payments by farmers.[1]

3. Farmers who are conserving water would have decreased bills under this scenario, while farmers who use more water would have increased bills. The increased bills would signal to farmers that they should examine their water-use practices.

4. This changed billing system would eliminate the current unfair competition between Santa Clara-supplied water and water from alternative sources, including cisterns and reclaimed water. It would also minimize the pressures for intra-district water trading that were experienced during the 1991 drought (when farmers offered to resell their subsidized water to manufacturers at a profit).

This option would therefore overcome the current disincentives to efficient water use, while maintaining an even-stronger support for open space in the county. Under the current arrangement, a farmer could sell half of his land for development, double the rate of water use on the remaining acreage, and still receive the same financial benefit for the reduced level of open space. Under the proposed modification, a farmer who sold half of his property to developers would lose half of the financial reward provided to encourage the maintenance of open space.

This direct subsidy could be used to more effect than the current indirect subsidy through water rates. For example, the District could refuse the subsidy to land-uses that would degrade water quality in the aquifer, such as feed-lots and other livestock agriculture. The District could also combine its subsidy with other agencies that are promoting maintenance of agricultural land-use or watershed protection within the county, and develop a more targeted and coordinated approach.

8. Other Issues

Several other issues have been raised as possible improvements to current practices for encouraging water recycling. These are discussed below.

A Tax on Imported Water: It has been suggested that wastewater discharges in excess of flow caps arise because water is imported into the county. According to this approach, the excess wastewater flow could be overcome by a tax on imported water which was sufficient to discourage use of imported water. In fact, the direct cause of the excess flows is the level of indoor water use in the county. A tax on imported water could result in decreased outdoor water use while leaving indoor water use (and thus wastewater flows) relatively unchanged. The recent drought experience suggests that this could be the case. The largest part of household reductions in water use during the drought came from reductions in landscape irrigation, suggesting that householders perceive outdoor water use as less valuable than indoor water use. Because of this, a tax on imported water would be unlikely to reduce wastewater flows significantly, and would be more likely have the following impacts:

- reduced disposable income for county households; and,
- reduced quality of life in the county through loss of landscape.

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[1] Based on an assumed annual average use of one AF per acre.

The county agencies could attack the problem more effectively by taxing indoor water use or wastewater outflows, if taxation is the tool of choice. Alternatively, the agencies could cooperate to institute a vigorous conservation program targeted at indoor water use.

District Outreach Program: District staff has considered that some proportion of the District's investment in recycling programs might be better spent on an outreach program administered by the District, and targeted at improving the acceptance of recycled water. This option does not seem appropriate at this time. Currently, most of the recycled water programs are small in scope, and rely on one-on-one interaction between the end-user and the wastewater supplier. In many cases, the end-user is the parks or landscape department of the same city that is supplying the recycled water. In such situations, the District can provide little useful assistance. The District cannot provide any more information about water quality, or provide any guarantee of consistency of supply or quality that cannot be more readily provided by the wastewater staff to their fellow city employees.

Future programs might motivate a review of this recommendation. If there are larger scale programs where the end-users are not cities but other landscape or agricultural users, or where public safety is a concern, the District might more usefully conduct classes or outreach programs to educate the public or potential targets for marketing of recycled water. In situations where the District acts as a wholesaler of recycled water, the District could set consistency standards for water quality or supply that it would require of the supplier and promise to the end-users. Under such circumstances it could prove useful for the District to conduct a marketing plan that explained this aspect of the program to the target users.

9. Conclusion

Recycled water programs in Santa Clara County offer the following benefits:

- low-cost approaches to meet environmental regulations:
    - reduced stream flows to avoid conversion of salt water marshes; and,
    - reduced mass loadings discharged to the Bay;
- limited water supply benefits;
- limited local economic benefits;
- political benefits; and,
- potential for environmental improvements above those required by regulation.

Recycled water is not currently needed for its water supply benefits. From a water supply perspective, water recycling programs should be delayed until there is an improved understanding of the future level of water demand, and until the outcome of the CALFED process is more clear. However, if dry-year option water transfer markets fail to develop, supplies from recycled water will become much more important to the District.

The near-term water supply and local economic benefits could be achieved either through conservation or recycled water. An aggressive water conservation program could also solve much of the marsh conversion problem, and could provide many of the political benefits that could accrue from support for recycling programs. The District should move aggressively to develop conservation programs aimed at indoor water use in coordination with local wastewater agencies. However, conservation cannot address some of the potential environmental benefits that could be gained from recycled water.

It is also clear that both conservation and recycling will become increasingly valuable in the future, as the District more closely approaches the limits of its current water supplies. Incentives paid to recycling programs should increase over time to reflect this increase in value. This can be achieved by using a levelized payment that reflects the discounted cost of future supplies that can be avoided by recycling. But these new, higher incentives should only be paid to those programs coming on-line at that future time. Recycling programs commenced in the near future should have lower incentives to reflect the lower benefits that will accrue to the District over much of the project's life.

Conservation and recycling offer similar benefits to the District, and so the level of incentive the District provides for recycled water should match the marginal cost per AF of current District spending on conservation. Recycled water is less valuable to the District than dry-year options. The greater flexibility of scheduling and the higher quality of water provided make dry-year options more valuable as a future water supply. Water banking and water recycling are also not substitutes. The higher level of wet-year supplies that result from water recycling make water banking more valuable, and an increase in water recycling may lead to an increase in water banking. The two water management options are complements, not substitutes and so the incentive for water recycling should not be related to the cost of water banking.

The District's agricultural rates pose an ongoing problem for recycled water programs. The District offers a single incentive level to recycled water both for agricultural and M&I uses. Through this approach, it subsidizes the use of potable water for agriculture and removes the subsidy for recycled water used in agriculture. This is not appropriate. The current incentive is calculated based in part on lost revenues. When recycled water programs serve agricultural uses the lost revenues are much lower, and the incentive should be altered to reflect that fact. This maintains the current subsidy to agriculture even when the District is no longer supplying water. This change would provide an incentive for recycling programs to target agricultural uses when these may not be the most appropriate end-uses for the water. Changing the agricultural water rates to full cost, while changing the present subsidy to a direct payment for land-use would provide benefits.

In summary, the District's current incentive level for recycled water is reasonable, or even generous, although the incentive for agricultural use should be higher. The District incentive should be similar to the current cost per AF of conserved water. Both the spending on conserved water and the incentive for recycled water programs should be revised upward over time, to reflect the growing value of these programs to the District as the demand for water approaches the capacity of the District's current supplies. The higher incentive levels should apply only to those recycled water programs coming on-line at that time, and not be applied to programs that are already operating. In addition, the District should consider changing its current agricultural rate policy and developing an aggressive conservation program aimed at indoor water use in conjunction with the county's wastewater agencies.

Appendix

Environmental Issues in Santa Clara County

The main environmental impact of water recycling in Santa Clara County may be on wetlands in the county. Water recycling could affect the quantity, distribution, and quality of three classes of South Bay wetlands: tidal salt and brackish/freshwater marsh, and riparian forest. Of course, these habitats affect and are affected by others. Marshes are affected by the composition and amount of runoff from uplands, flow from upper marshes affects lower marshes, and flows from tidal marshes affect intertidal and subtidal habitats. All of these wetland habitats are extremely diminished from their historical distribution. Over 80 percent of freshwater marshes in the Bay have been filled or otherwise converted, and a higher percentage of riparian forests have been lost. As a result, many of the plant and animal species of these habitats are listed under federal or state endangered species laws. Despite the losses, the remaining wetland habitats provide important services to plants and wildlife for habitat, and to people for flood control, water purification, recreation, and aesthetic values.

1. Overview of Habitat Types

There are three main natural habitat types that are likely to be impacted by recycled water. These are described below, and the representative plants and animals for these three wetland types are shown in Table A-1.

Salt Marsh habitats are dominated by highly salt-tolerant plants, whose distribution is determined by tidal height. Cordgrass grows from mean sea level to mean high water, where pickleweed begins to dominate. Organic matter from the salt marsh affects intertidal mud flats, where benthic invertebrates feed on detritus and in turn provide critical feeding stops for shorebirds and waterfowl along the Pacific Flyway.

Brackish Marsh occurs on the continuum where fresh water flows from creeks mix with salt water from the Bay. Plant communities range from salt-tolerant saltgrass near the Bay to cattail and bulrush as the salt content drops. Freshwater Marsh is dominated by cattails, tule, and reeds.

Riparian Forest grows along rivers, creeks, and streams flowing into the estuary. Cottonwood, sycamore, and bay laurel grow over willow, elderberry, and wild grape. The riparian forest preserves stream banks and provides shade to keep summer water temperatures low. Riparian forests are among the richest habitat types. A classic "edge" ecosystem, riparian corridors provide food, water, cover for numerous species. Sixty percent of Santa Clara County's bird species are found in riparian habitats, making them the richest avian habitats in the county.

2. Wetland Services

Wetlands provide society a wide range of services. These include services related to water supply, water quality, recreation, flood control, erosion control, riverbank stabilization, habitat for fish and wildlife, and food web support. Any particular wetland is unlikely to provide all possible wetland services, and even where wetlands perform similar services they may do so with varying levels of productivity. For example, wetlands that are linked to rivers or seas generally provide more services because of their ability to act as spawning and nursery areas for species that will migrate back to the oceans or rivers. Isolated or seasonal wetlands such as prairie potholes do not have this broad potential, but may still provide significant services. The wetlands along rivers and creeks flowing into San Francisco Bay are among the most productive ecosystems, and losses over the past 150 years make the services they provide that much more valuable. The services provided by wetlands are described in more detail below.

Table A-1
Representative Plants And Animals
Of Selected Wetland Types

Habitat	Plants	Fish	Birds	Mammals
Salt Marsh	Pickleweed Cordgrass Saltgrass	Top smelt Arrow gobi Yellowfin gobi Staghhorn sculpin	Ca. Clapper rail Black-legged stilt Salt marsh song sparrow Mallard	Salt marsh harvest mouse Salt marsh vagrant shrew Harbor seal
Brackish/Freshwater Marsh	Tule Cattail Alkali bulrush	Splittail Delta & longfin smelt Stickleback Chinook salmon	Snowy egret American coot Great blue heron Marsh wren	Salt marsh harvest mouse Salt marsh vagrant shrew Muskrat River otter
Riparian Forest	Cottonwood Willow Sycamore Elderberry	Carp Bluegill Squawfish White catfish	Wood duck Belted kingfisher Green heron Great egret	Black-tailed deer Raccoon Opossum Ornate shrew Deer mouse

Source: *State of the Estuary, 1992*

2.1 Food Web Support

Much of the Bay's primary production occurs in tidal salt and freshwater marshes. Primary production by plants and photosynthetic bacteria forms the foundation of the food chain. Marsh vegetation is the primary producer, creating biomass that is then consumed by organisms higher in the food chain. Marshes are among the most productive ecosystems found anywhere. As shown on Figure 1, bay freshwater tidal marshes are more productive than pickleweed salt marshes.
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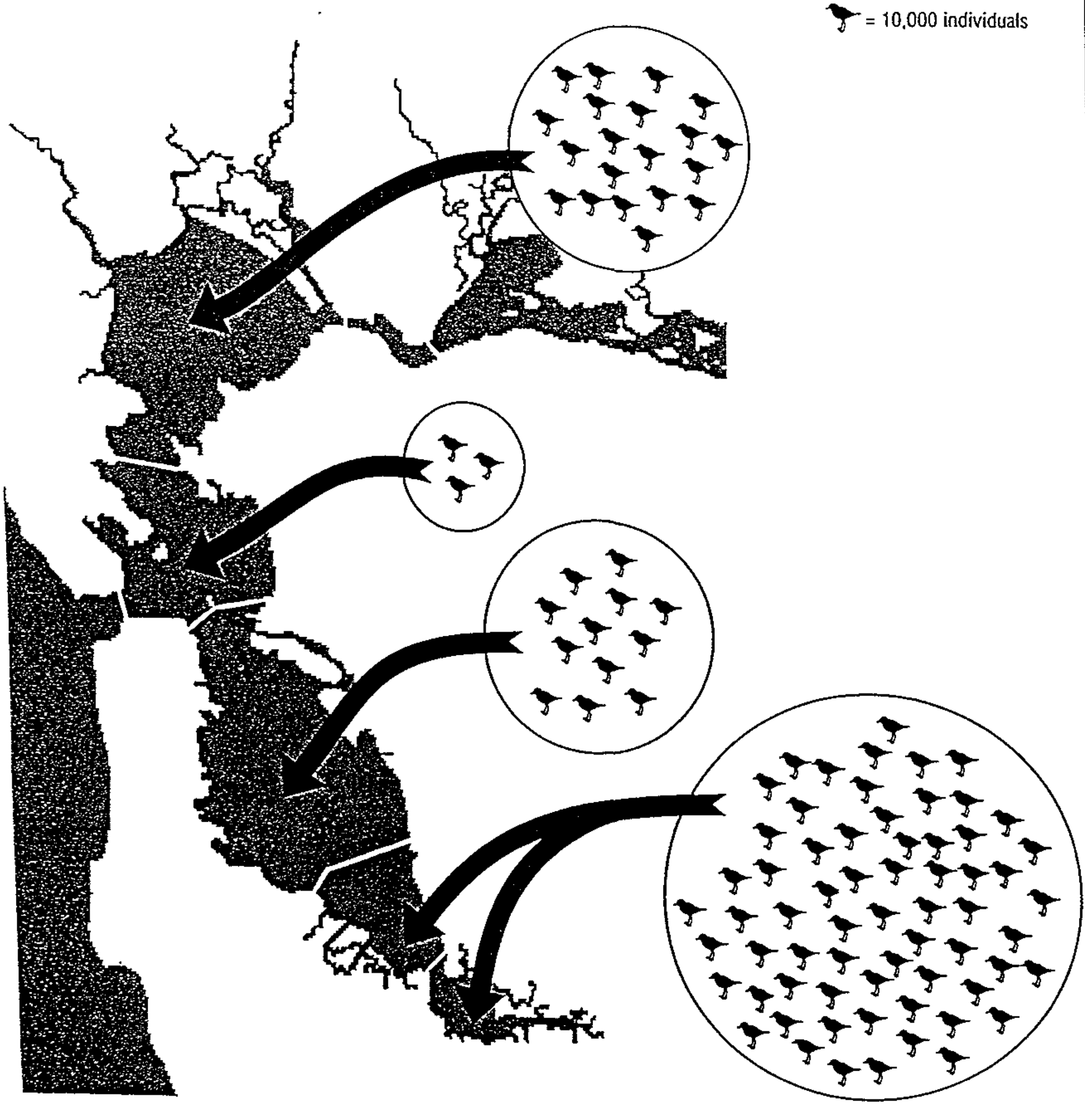
2.2 Fish and Wildlife Habitat

The high primary productivity of tidal marshes supports a diverse array of fish and wildlife species. Wetland conversion has caused many of these species to become threatened, and many are listed under state and/or federal endangered species laws. Table A-2 shows the animal species that have been listed under those laws, and are found in wetland habitats in Santa Clara County. Maintenance of fish and wildlife habitat and ecological processes indirectly supports many services, including fishing, hunting, and wildlife viewing. Modifying habitat to protect one species may have adverse effects on others. For example, freshwater conversion of former salt marshes may benefit the California red-legged frog at the expense of the California clapper rail and salt marsh harvest mouse.

Bay tidal marshes support not only resident species. Situated along the Pacific Flyway, the South Bay's wetlands provide crucial feeding and resting stops for migrating shorebirds and waterfowl. Figure 2 shows the relative importance of South Bay salt ponds, mudflats, and tidal marshes for shorebirds.

People place high values on maintenance of fish and wildlife habitat. For example, bird watchers travel from around the world to catch a view of the elusive and endangered California clapper rail. The values people assign to fish and wildlife habitats are largely captured in recreation and aesthetic values as discussed in section 2.5 below)

Figure 2
Shorebird Use of San Francisco Bay



Source: *State of the Estuary*, 1992.

2.3 Flood and Erosion Control

Wetlands serve to slow and absorb floodwaters, decreasing the damage and erosion resulting from floodwaters. In detention basins, tidal marsh can be used for flood water storage and catchment. The Palo Alto Flood Control Basin is an example. It is unlikely that salt or freshwater marsh provides differing values in this respect. Tidal marshes also serve to trap sediments, preventing erosion and silting of waterways, as well as building-up buffers against wave action from the Bay. In flood control channels, wetlands slow flows, protecting stream banks from erosion and maintaining the primary stream channel.

2.4 Water Quality Improvement

Tidal wetlands enhance the quality of runoff flowing into the Bay by catching sediment, removing nutrients, and trapping pollutants. A marsh's biological uptake of pollutants does not necessarily remove pollutants from the food chain altogether, however.

2.5 Recreation

The Bay's tidal marshes provide valuable open space for all manners of outdoor recreation: walking, bird watching, bicycling, etc. It is unlikely that these uses will vary much with salt/freshwater marsh composition. Recreational values can be divided into two categories: consumptive and non-consumptive. Consumptive activities include hunting and fishing, while activities such as bird watching are non-consumptive—these services can be provided repeatedly without decreasing their stock. While consumptive values are more easily determined by looking at hunting and fishing fees and permit costs, non-consumptive values can be high as well. One study found wildlife viewing values for Central Valley wetlands of $170 per participant annually. Recreation use of wetlands can have detrimental impacts on wildlife. Recreational amenities need to be balanced with wildlife's need to remain unmolested by human activities.

2.7 Aesthetic Values

These services relate to the aesthetic qualities that people attach to open space and to ecosystems that support plant and wildlife habitat. The presence of wetlands may add to the perceived attractiveness of a locality. Studies have found that this attractiveness translates into higher property values for nearby residences. One study, utilizing two estimation techniques, found that residential properties abutting wetlands were worth 17.5% more than comparable properties elsewhere and that property values increased $380 per acre of abutting wetlands. Properties do not have to be directly adjacent to wetlands to benefit from aesthetic values, however. For example, residents may choose to live in the Bay Area over other urban areas partly due to the relative abundance of open space and parks. These preferences may be translated to property values region-wide, not just to those properties directly adjacent to open space.

3. Effect on Stream Flows

Water recycling could give the District expanded flexibility in meeting current or future minimum stream flow requirements. The California Department of Fish and Game (CDFG) has recently made a recommendation to the State Water Resources Control Board that the District's water diversion rights be revised. CDFG wants the Board to require higher cold-water stream flows on Guadalupe River and Stevens and Coyote Creeks, primarily to protect trout species (rainbow and steelhead are two major species). If recycled water could be substituted for dam releases, the District could meet increased stream flow requirements without decreasing deliveries of potable water. While CDFG's recommendation is only that, and the amount and timing of any changes to minimum stream flow requirements has not been specified by SWRCB, water recycling does provide a potential option to ease future uncertainties. It should not be assumed, however, that using recycled water to augment stream flows will meet with approval by regulatory agencies or the public. Other agencies have had problems with public opposition (for example, the South County Regional Wastewater Authority's plan to release recycled water in the Pajaro River).

Using recycled water to augment stream flows could have benefits in addition to meeting regulatory requirements. To the extent that riparian corridors and other wetlands are created, enhanced, or maintained throughout the dry season, the wetland values described above would be gained. Because new wetlands may be created (as opposed to only changing the type of existing tidal marsh near the Bay), increases in wetland values from water recycling may be greater in upland areas.